Fig. 1

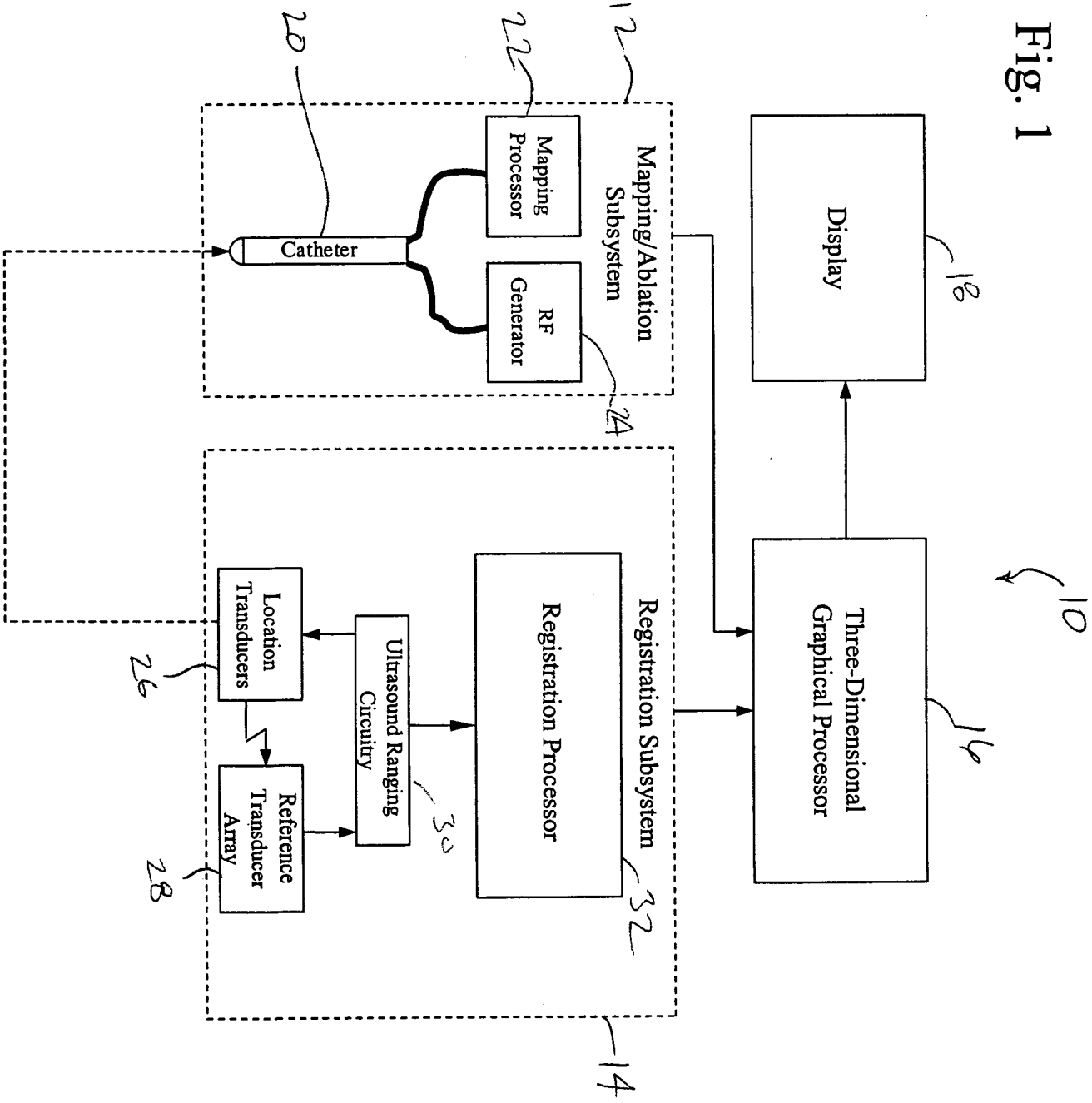

10
Display
18
Three-Dimensional Graphical Processor
16
Mapping/Ablation Subsystem
12
Mapping Processor
22
RF Generator
24
Catheter
20
Registration Subsystem
32
Registration Processor
Ultrasound Ranging Circuitry
30
Location Transducers
26
Reference Transducer Array
28
14

Fig. 2

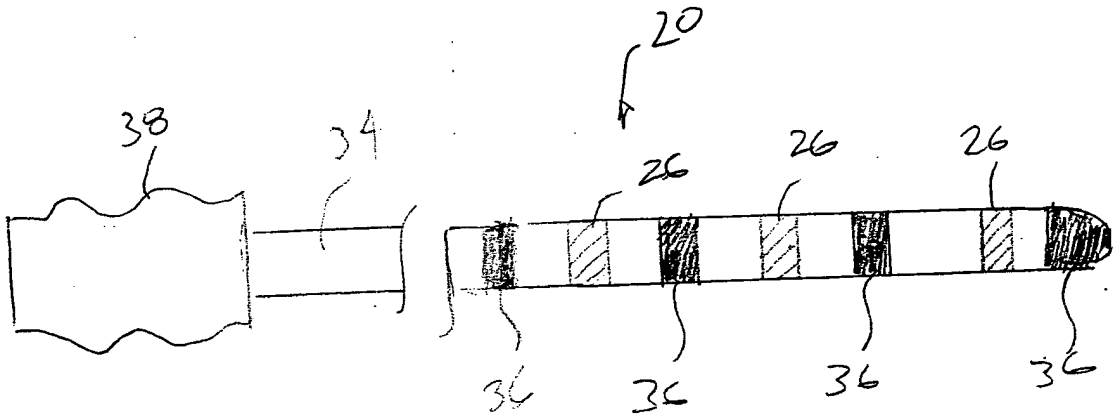
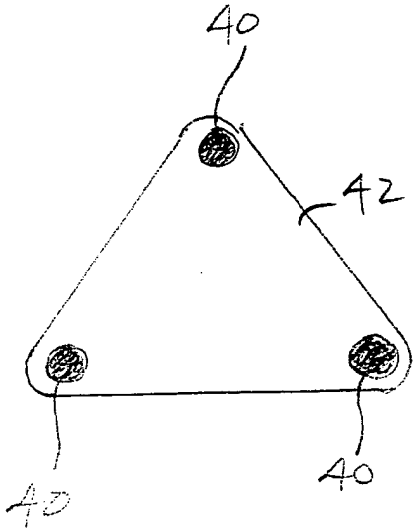


Fig. 3



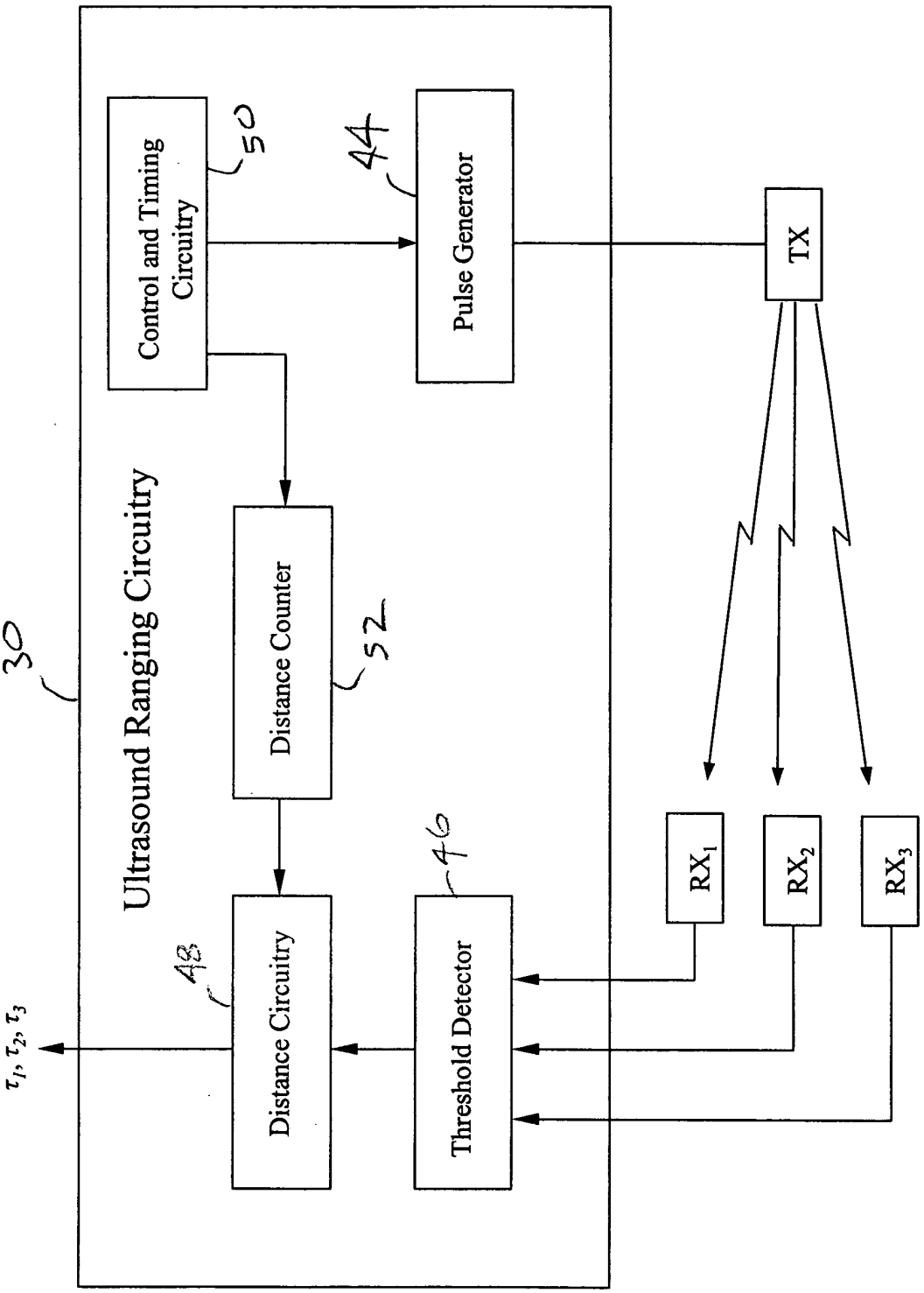

Ultrasound Ranging Circuitry
30
Control and Timing Circuitry
50
Pulse Generator
44
TX
Distance Counter
52
Distance Circuitry
48
Threshold Detector
46
RX1
RX2
RX3
τ1, τ2, τ3

Fig. 4

Fig. 5

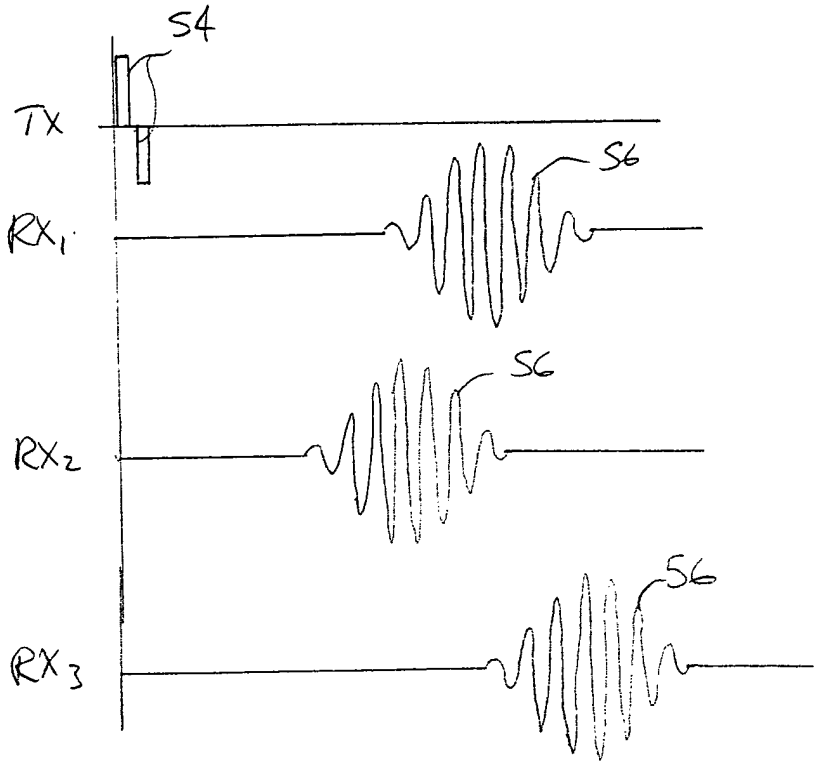


Fig. 6

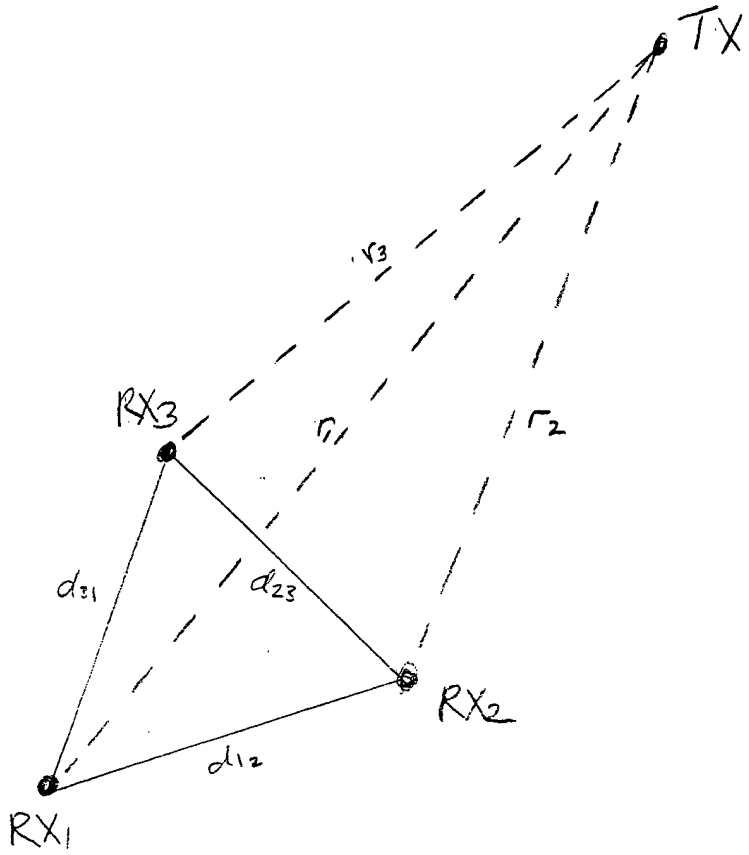


Fig. 7

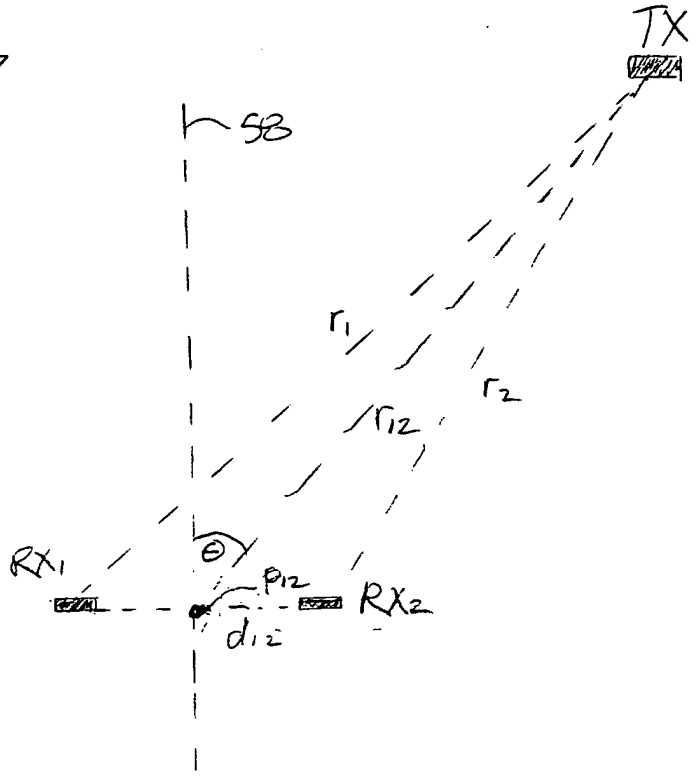
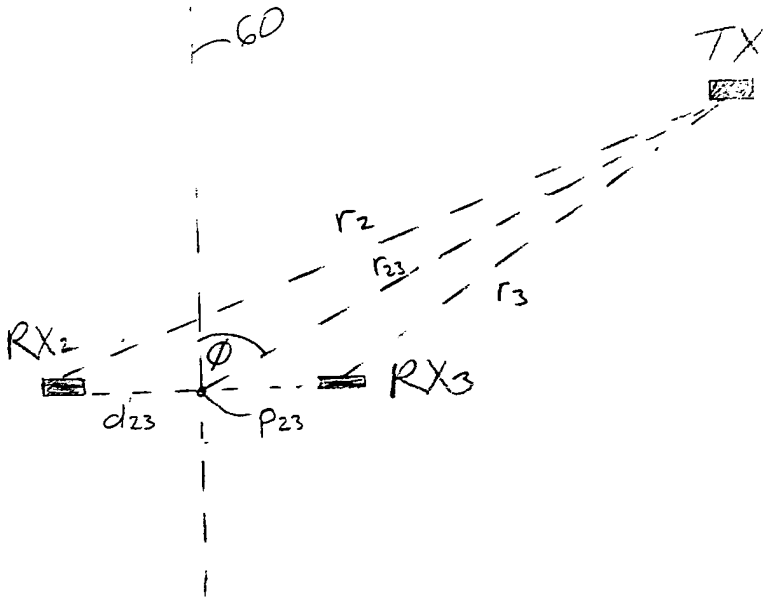

TX
58
r_1
r_2
r_{12}
RX_1
θ
p_{12}
RX_2
d_{12}

Fig. 8


60
TX
r_2
r_{23}
r_3
RX_2
ϕ
RX_3
d_{23}
p_{23}

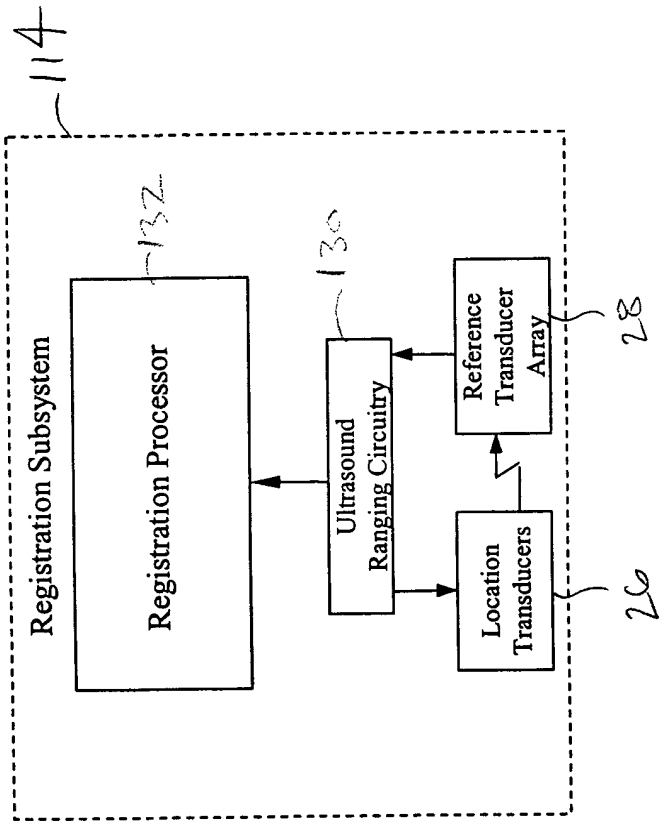

114
Registration Subsystem
Registration Processor
132
Ultrasound Ranging Circuitry
130
Reference Transducer Array
28
Location Transducers
26

Fig. 9

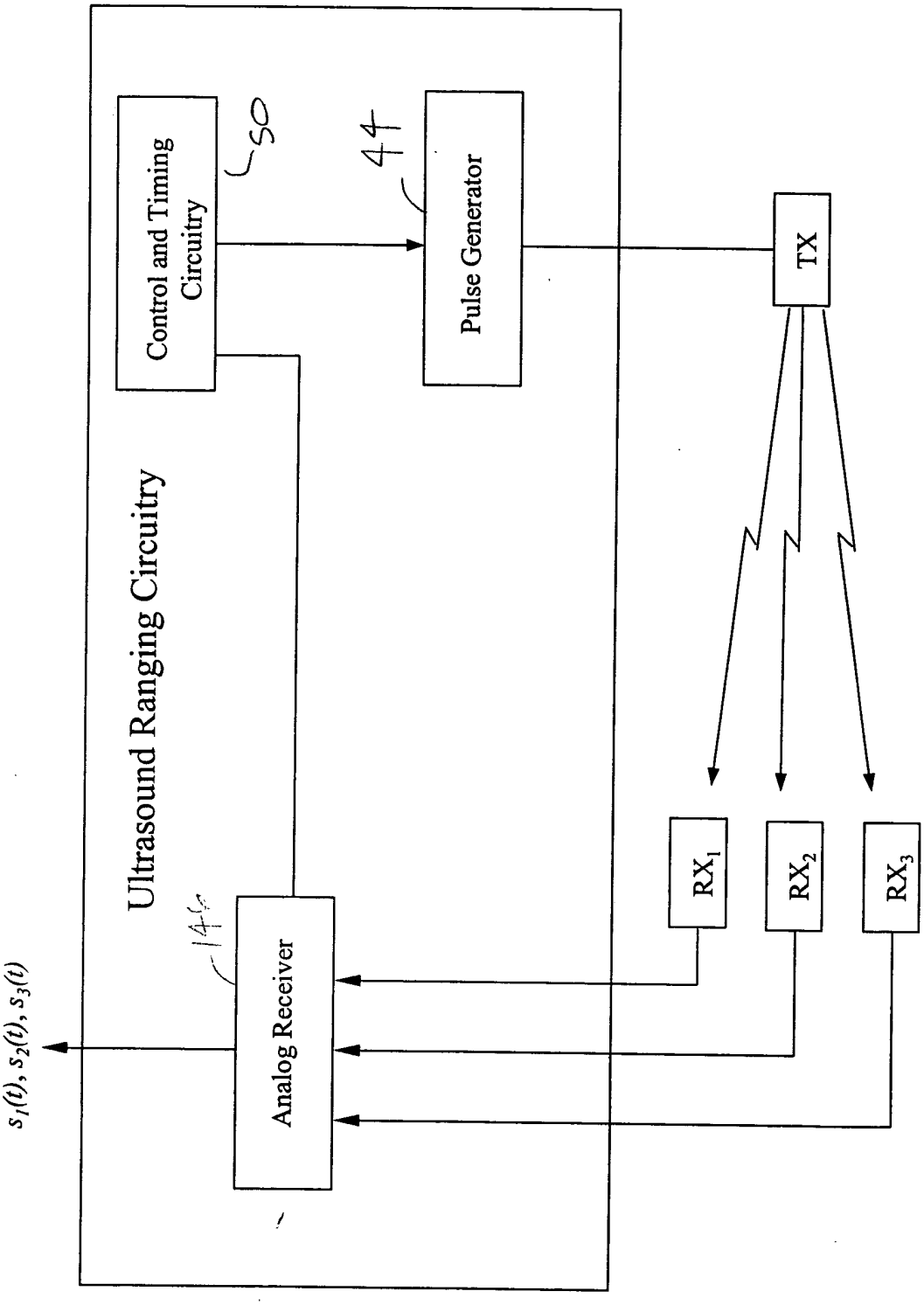

Ultrasound Ranging Circuitry
Control and Timing Circuitry
50
Pulse Generator
44
TX
RX1
RX2
RX3
Analog Receiver
142
s1(t), s2(t), s3(t)

Fig. 10

Fig. 11

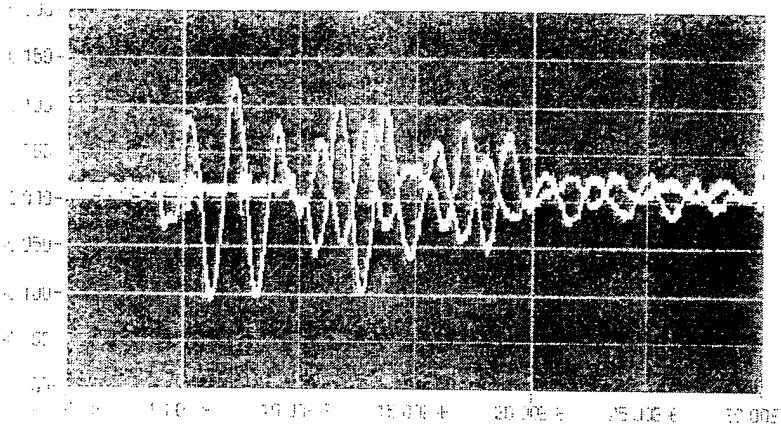


Fig. 12

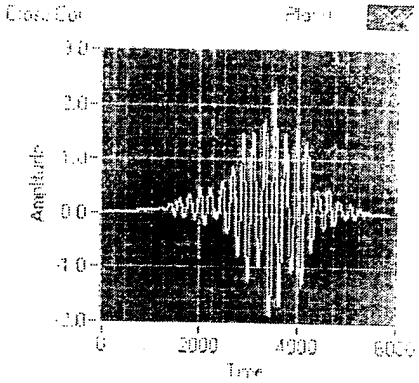


Fig. 13.

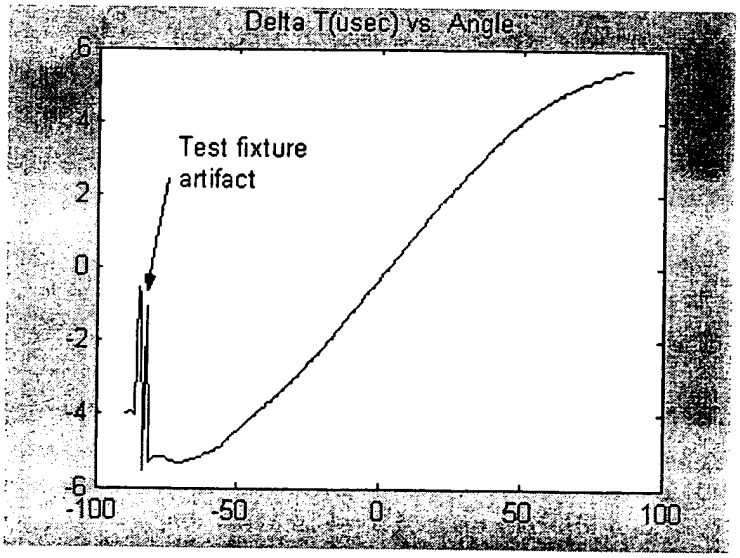
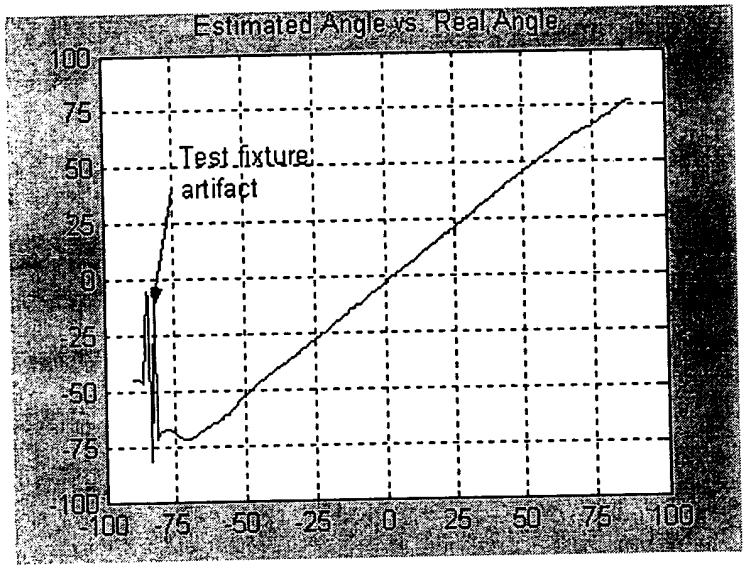


Fig. 14


Estimated Angle vs. Real Angle
Test fixture artifact
100
75
50
25
0
-25
-50
-75
-100
-100
-75
-50
-25
0
25
50
75
100